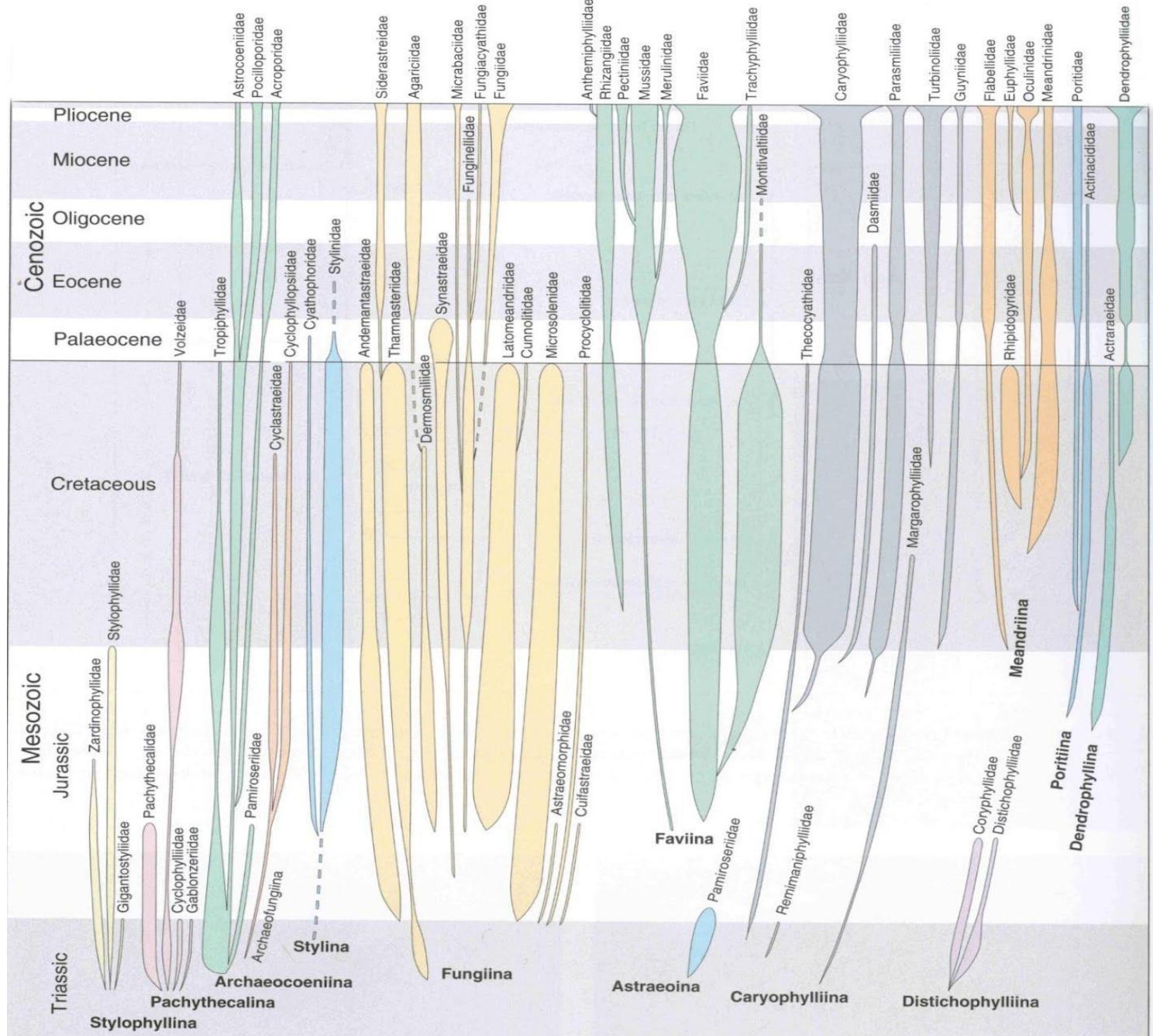
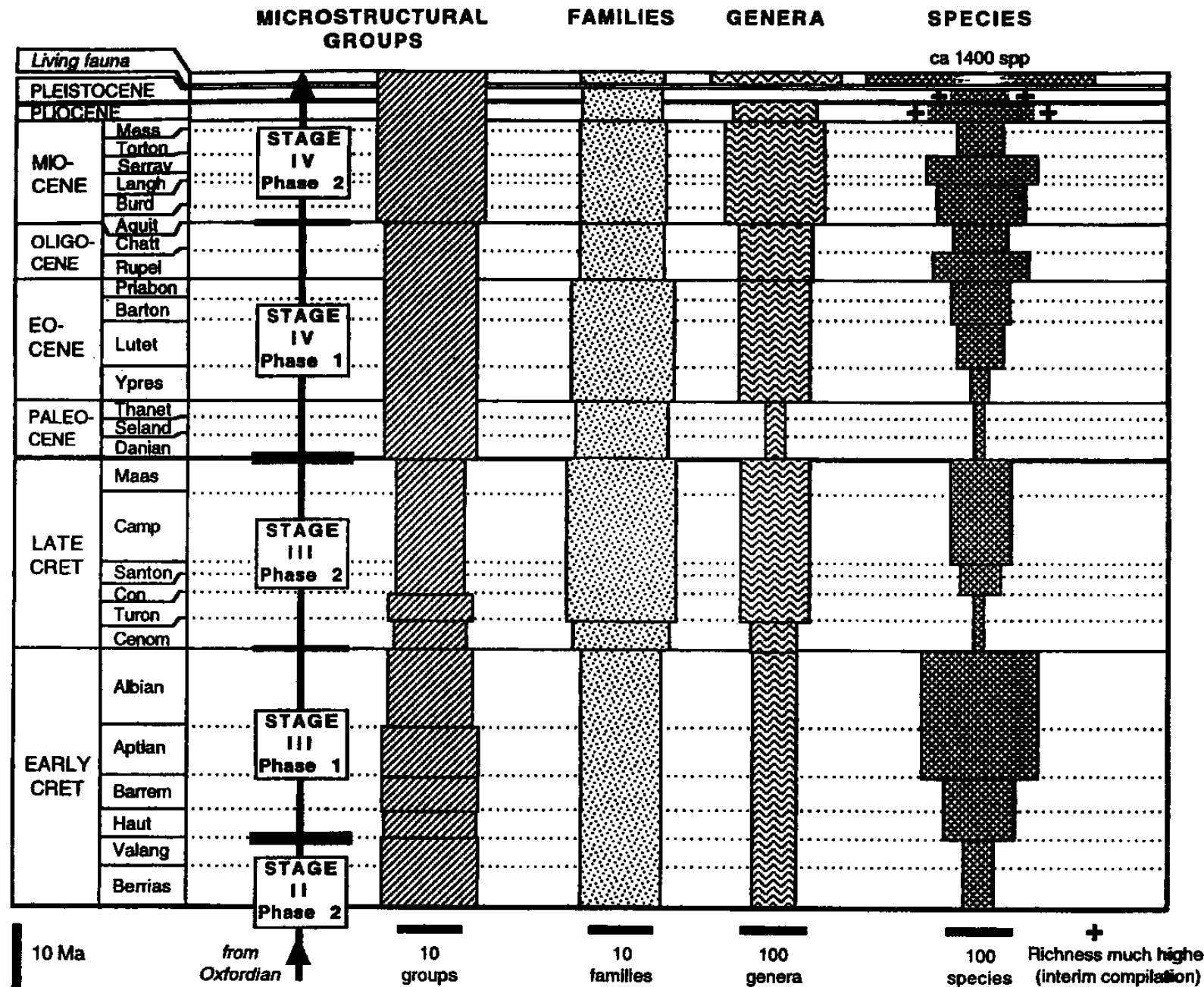
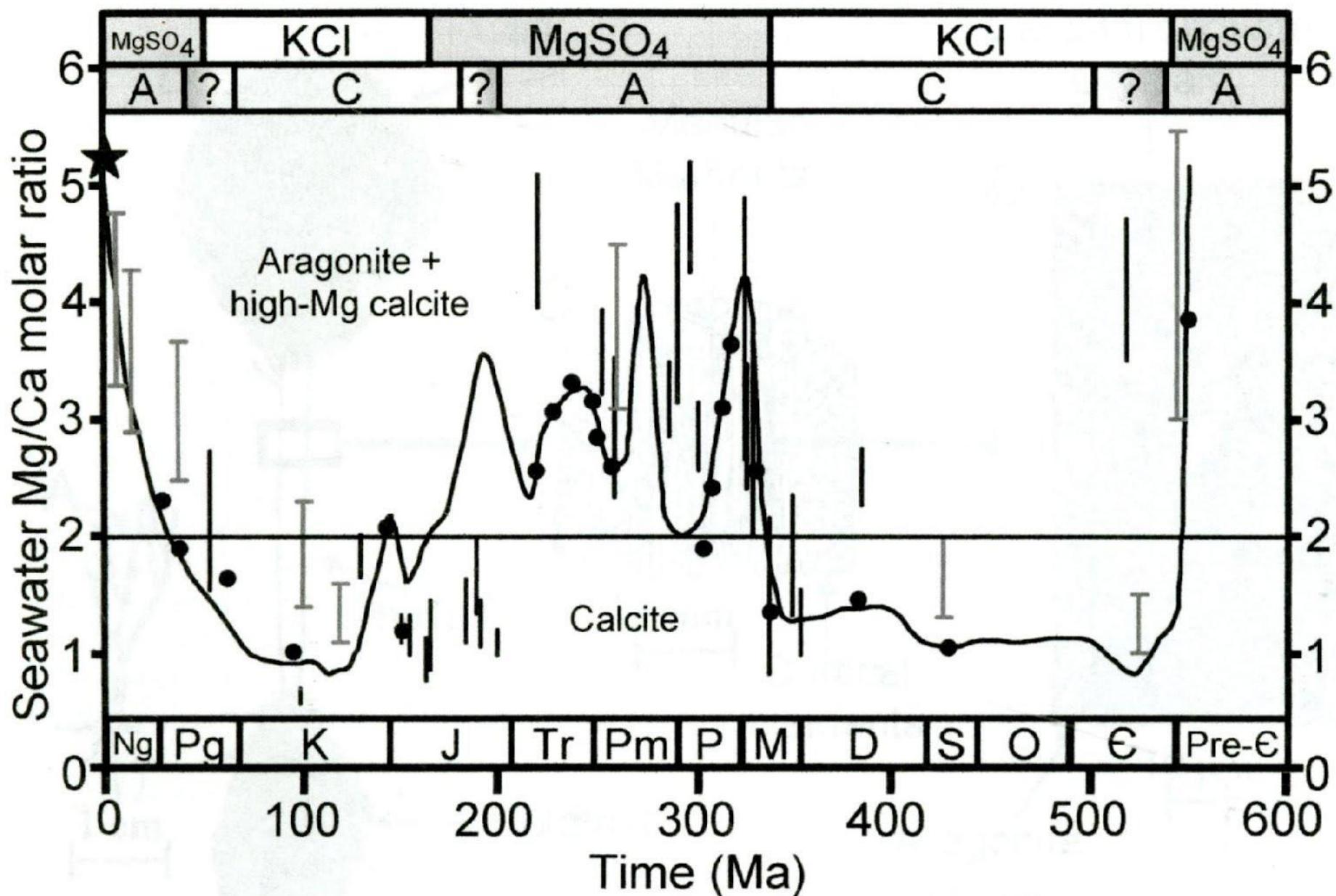


# **Summary of biological status review of risks to corals and coral ecosystems**

	<b>Percent Earth surface</b>	<b>No. animal phyla</b>
<b>All land above water (continents, islands)</b>	<b>29.2</b>	<b>12</b>
<b>Coral reefs</b>	<b>0.0006</b>	<b>30</b>







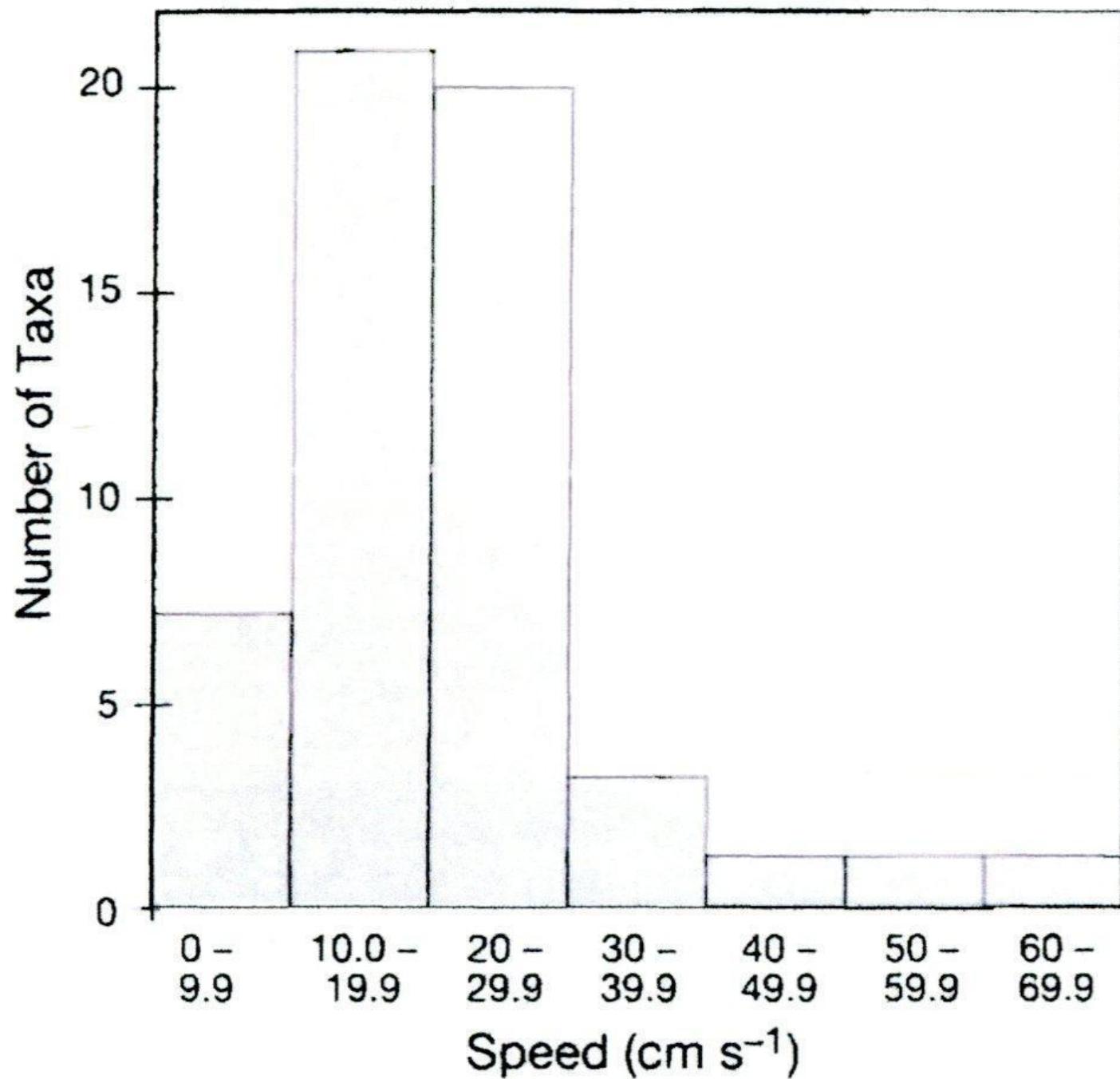


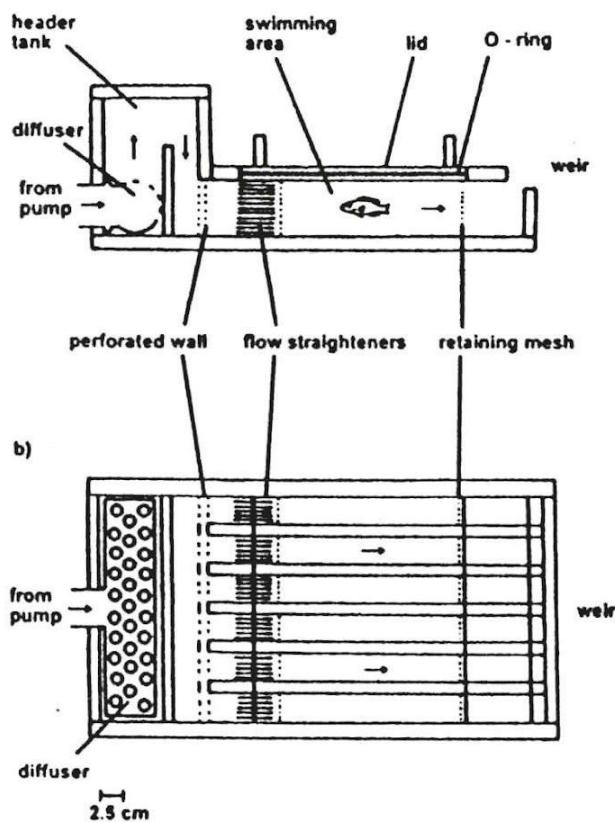


# **Caribbean Reef Development Was Independent of Coral Diversity over 28 Million Years**

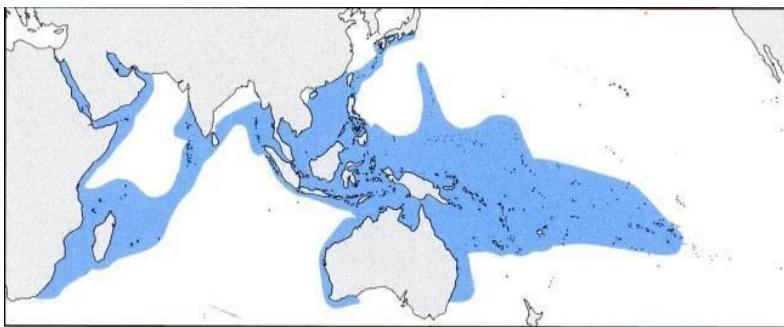
**Kenneth G. Johnson,<sup>1\*</sup> Jeremy B. C. Jackson,<sup>2,3</sup> Ann F. Budd<sup>4</sup>**

The relationship between natural variations in coral species diversity, reef development, and ecosystem function on coral reefs is poorly understood. Recent coral diversity varies 10-fold among geographic regions, but rates of reef growth are broadly similar, suggesting that diversity is unimportant for reef development. Differences in diversity may reflect regional differences in long-term biotic history in addition to environmental conditions. Using a combination of new and published fossil and stratigraphic data, we compared changes in coral diversity and reef development within the tropical western Atlantic over the past 28 million years. Reef development was unrelated to coral diversity, and the largest reef tracts formed after extinction had reduced diversity by 50%. High diversity is thus not essential for the growth and persistence of coral reefs.

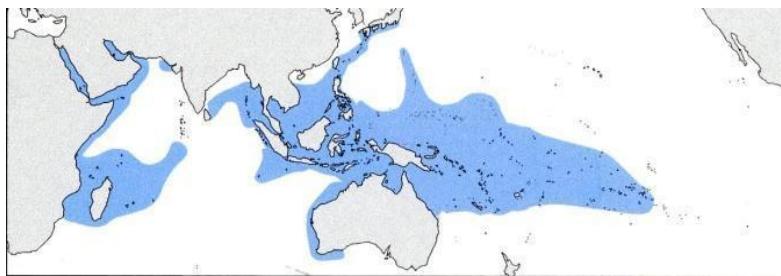




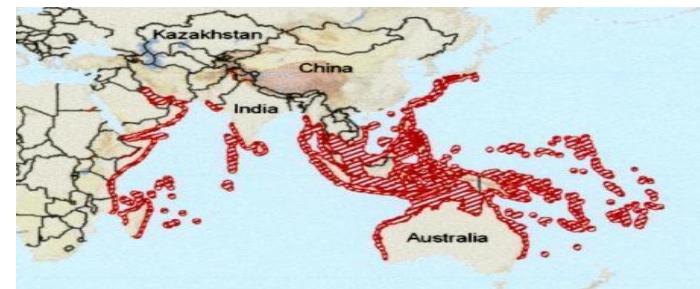
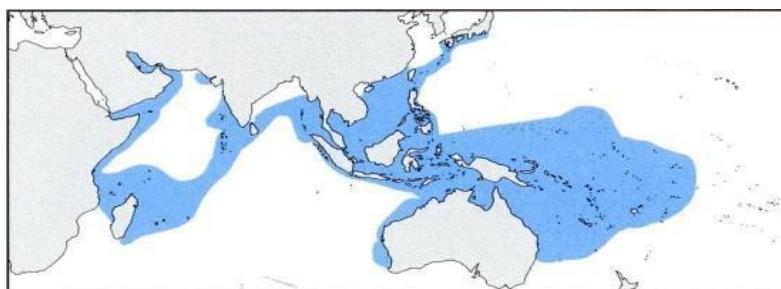
Family	Maximum duration (h)	Equivalent distance travelled (km)	Minimum duration (h)	Equivalent distance travelled (km)
Lutjanidae	288.5	140.2	25.9	12.6
Pomacanthidae	253.1	123	25.3	12.3
Acanthuridae	246.1	119.6	15.6	7.6
Chaetodontidae	243.1	118.1	6.3	3.1
Monacanthidae	238.7	116	16.5	8
Pomacentridae	231.7	112.6	0	0
Lethrinidae	228.3	110.9	0.33	0.16
Apogonidae	174.3	84.7	0	0
Nemipteridae	35.8	17.4	0	0



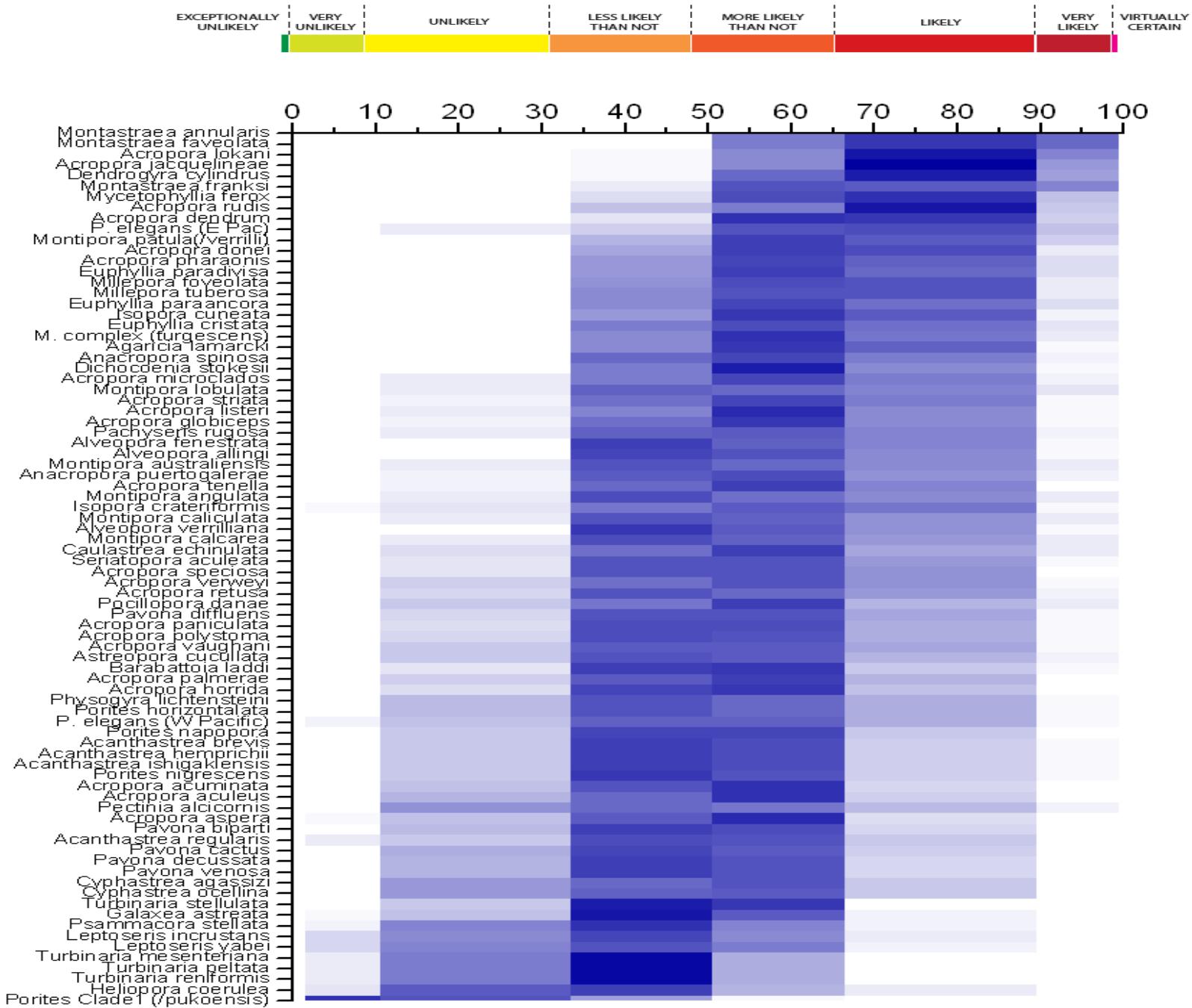
***Turbinaria mesenterina***



***Turbinaria  
reniformis***



***Turbinaria peltata***



**Mesozoic genera surviving K/T mass extinction,  
but recently went extinct in Atlantic**

*Astreopora*

*Goniopora*

*Hydnophora*

*Diploastrea*

*Leptoria*

*Heteropsammia*

## **Corals differ from previous species on ESA**

- 1 – Corals are “Foundation Species”, i.e., they make up the physical structure of the ecosystem**
- 2 – Corals are distributed by larvae affected by water currents**
- 3 – Many species of corals have immense geographic ranges**
- 4 – Petitioned 82 species representative of main families**
- 5 – Adult corals are sessile**

# **Allee effects on corals because adults are sessile**

**1 – fertilization**

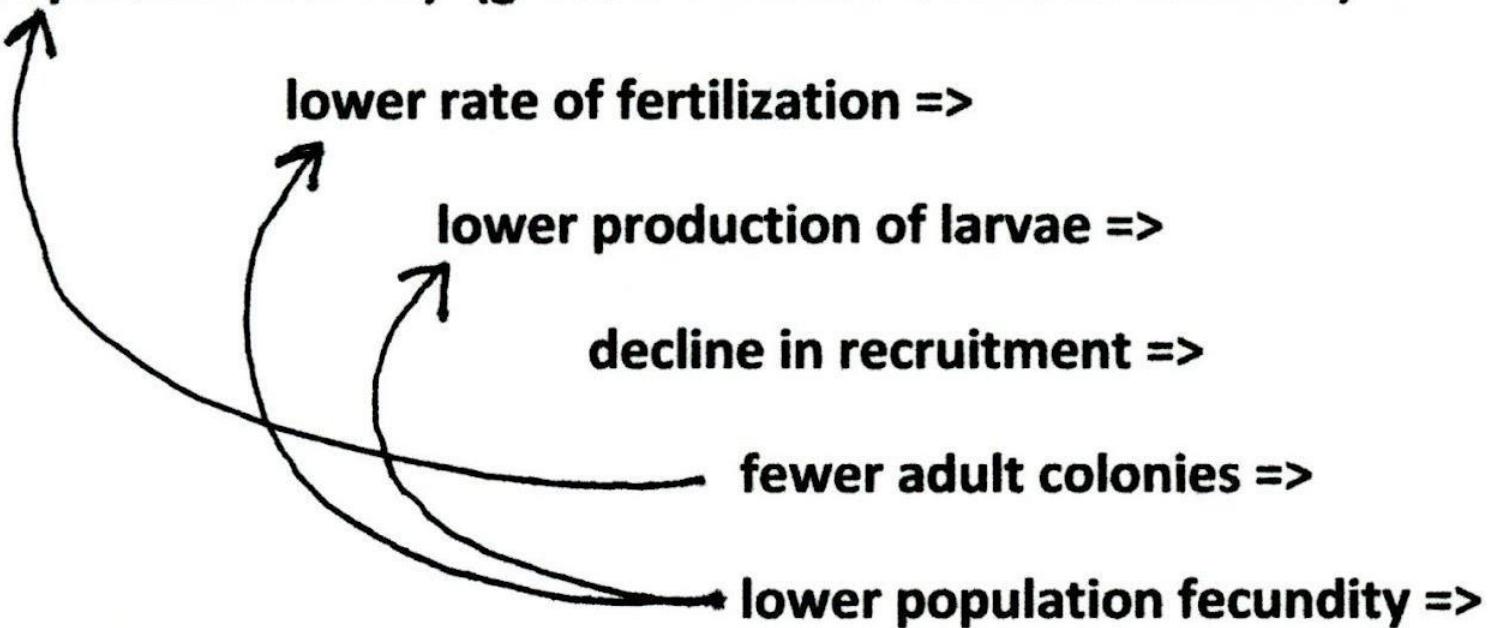
**2 – fecundity**

**3 – dispersion**

**4 – connectivity**

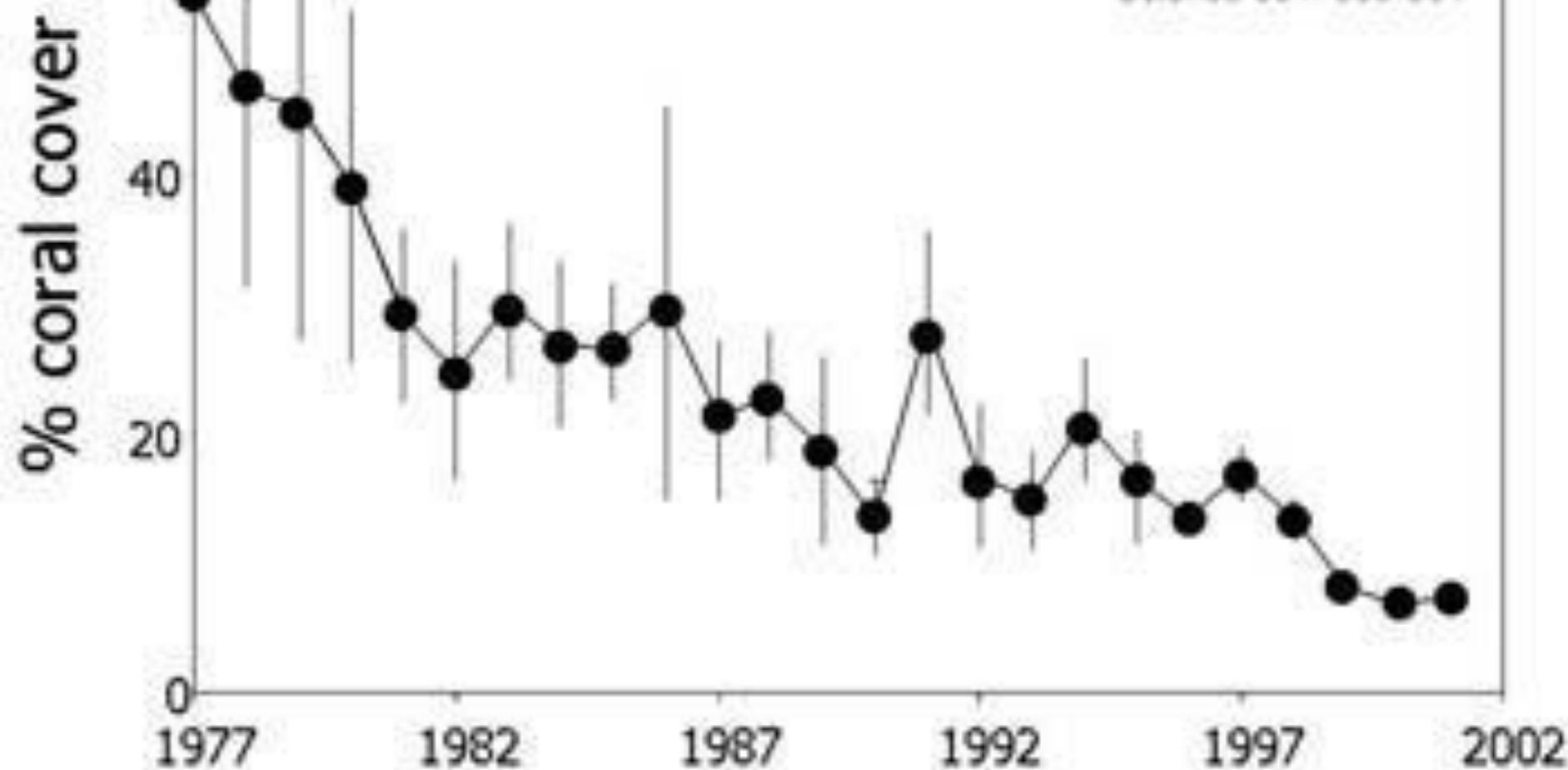
**5 - predation**

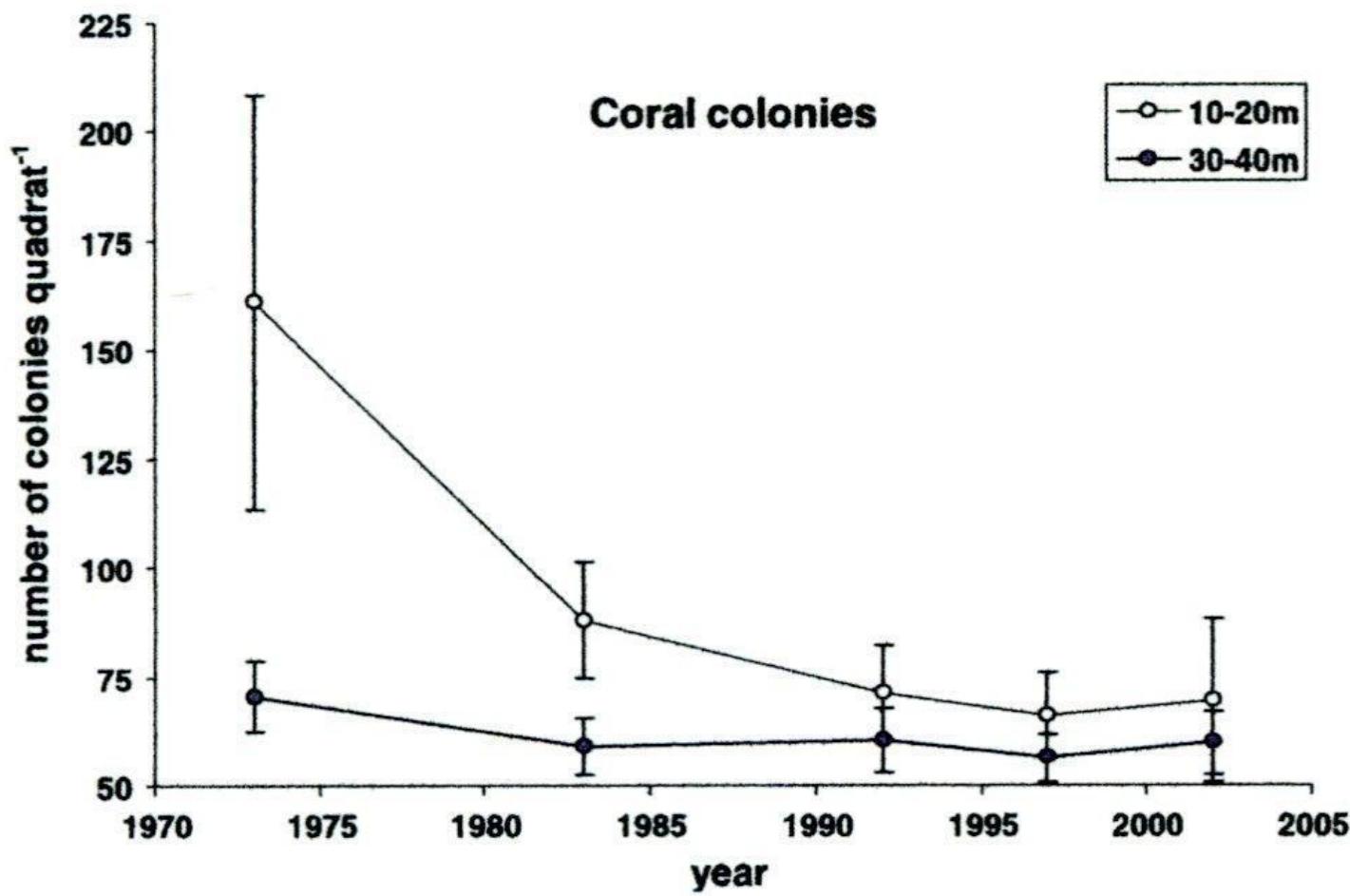
**lower population density (greater distance between colonies) =>**



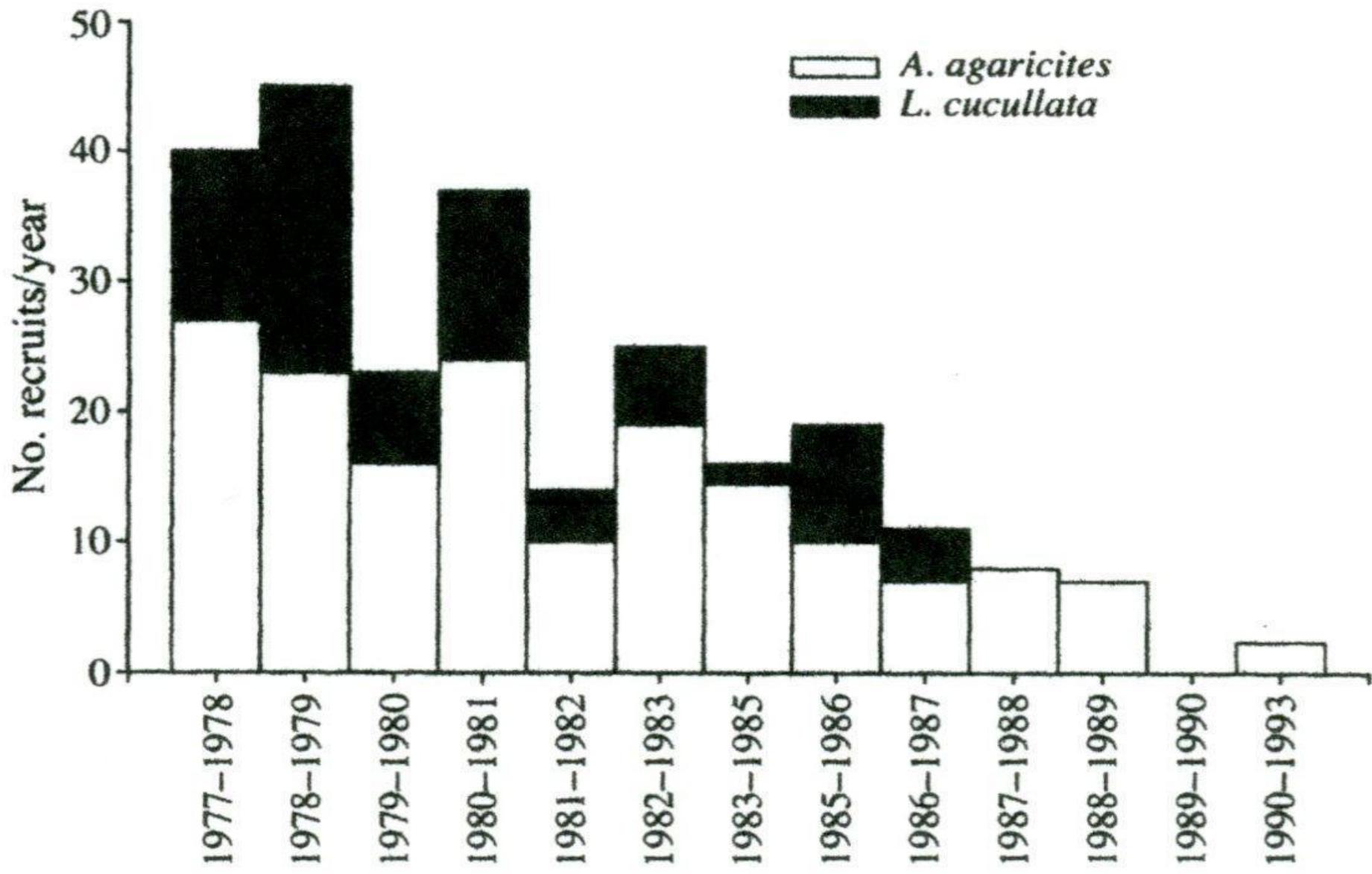
## Long-term region-wide declines in Caribbean corals

Gardner et al. 2003  
Science 301: 959-961





**Fig. 1** Number of coral colonies (mean  $\pm$  1SE) from 1973 to 2003 at two depths, 10–20 and 30–40 m



# Critical Risk Threshold (CRT)

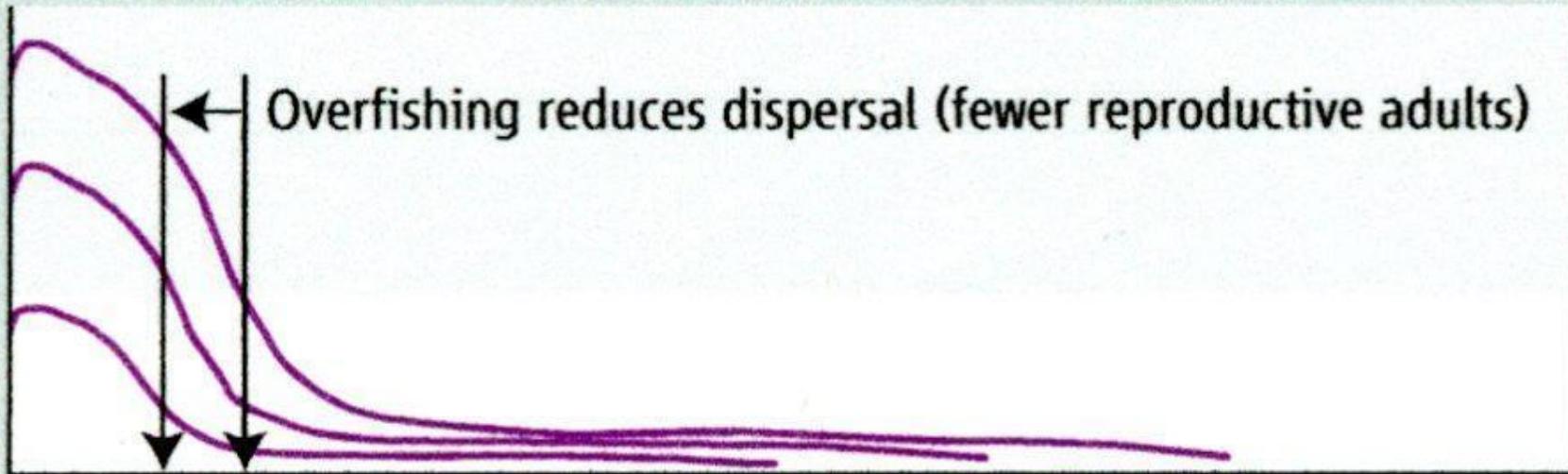
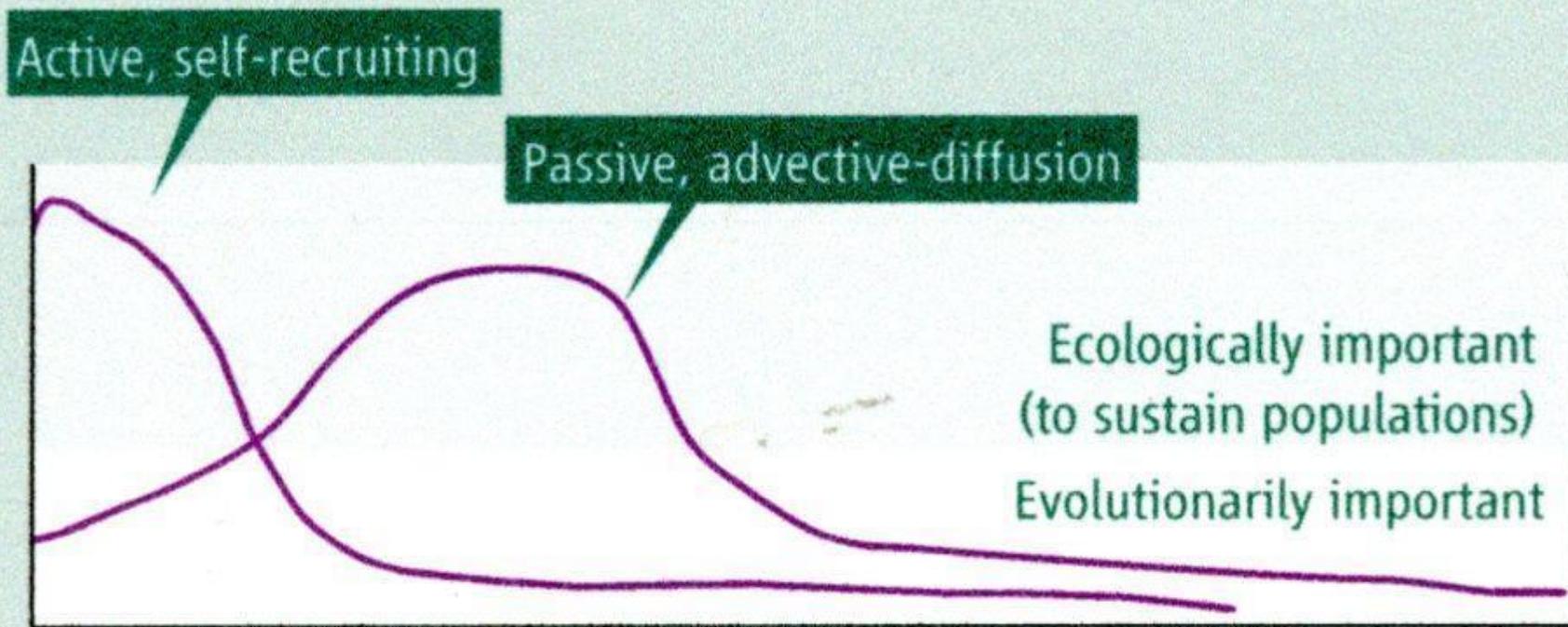
**FECUNDITY**

abundance

size distribution

stress

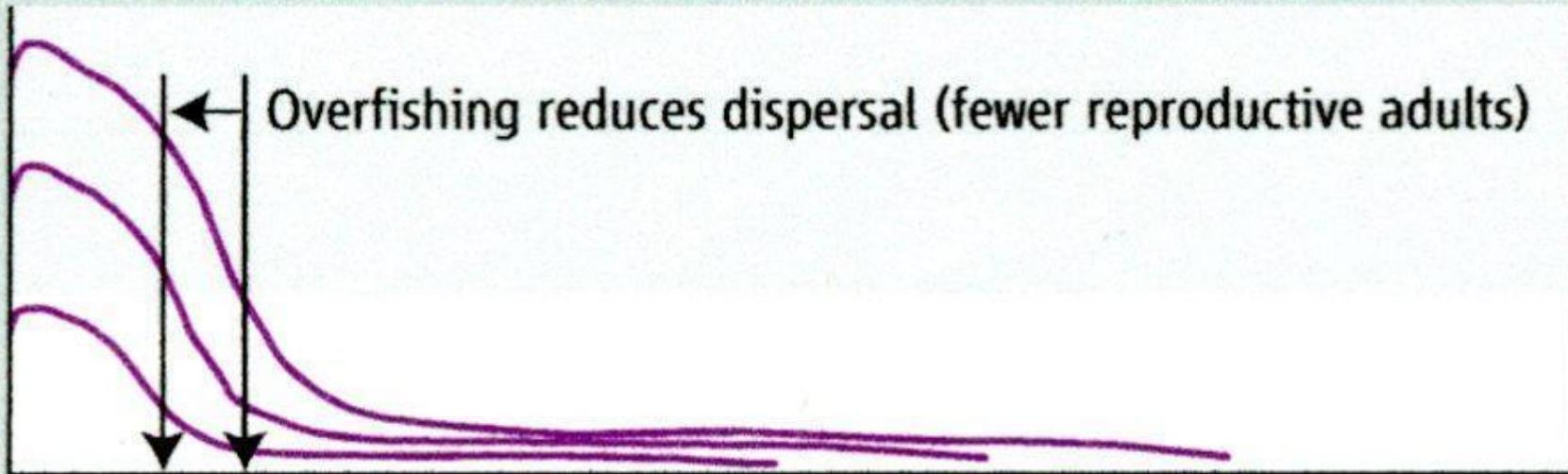
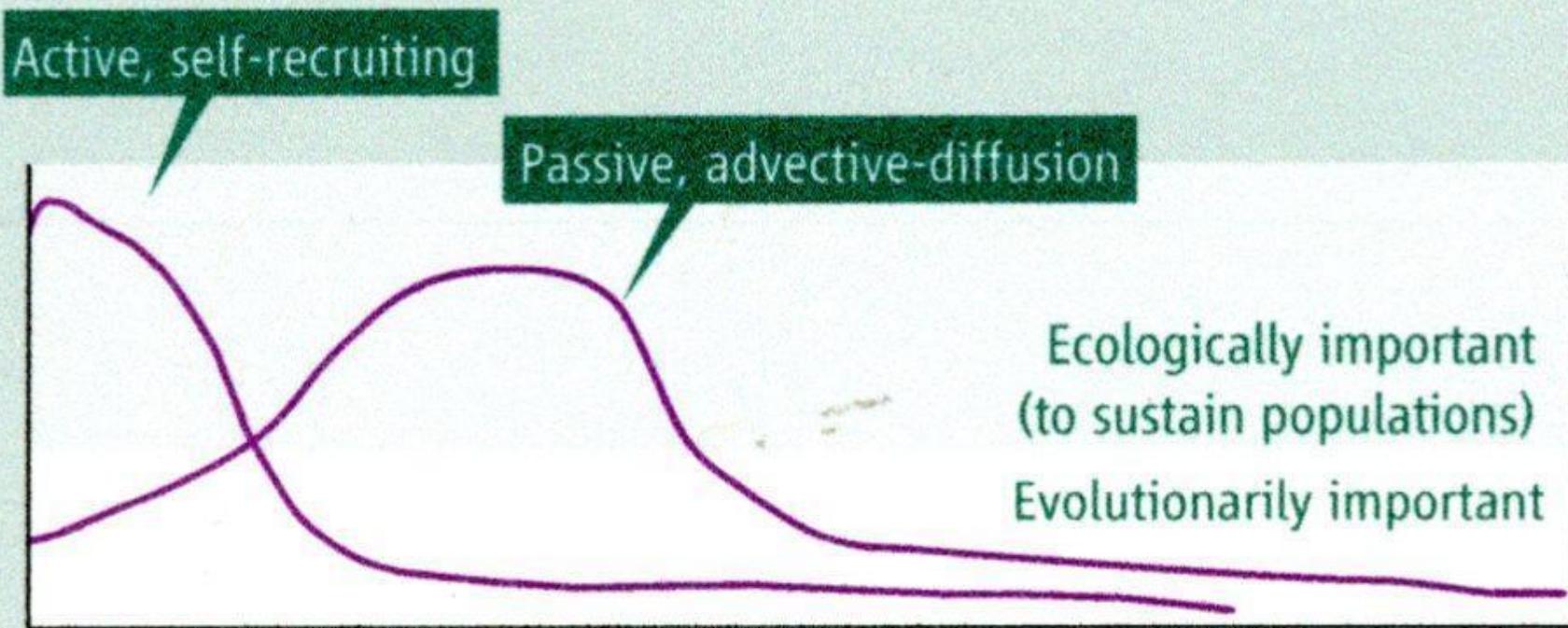
Number of successful recruits



Distance from larval source



Number of successful recruits

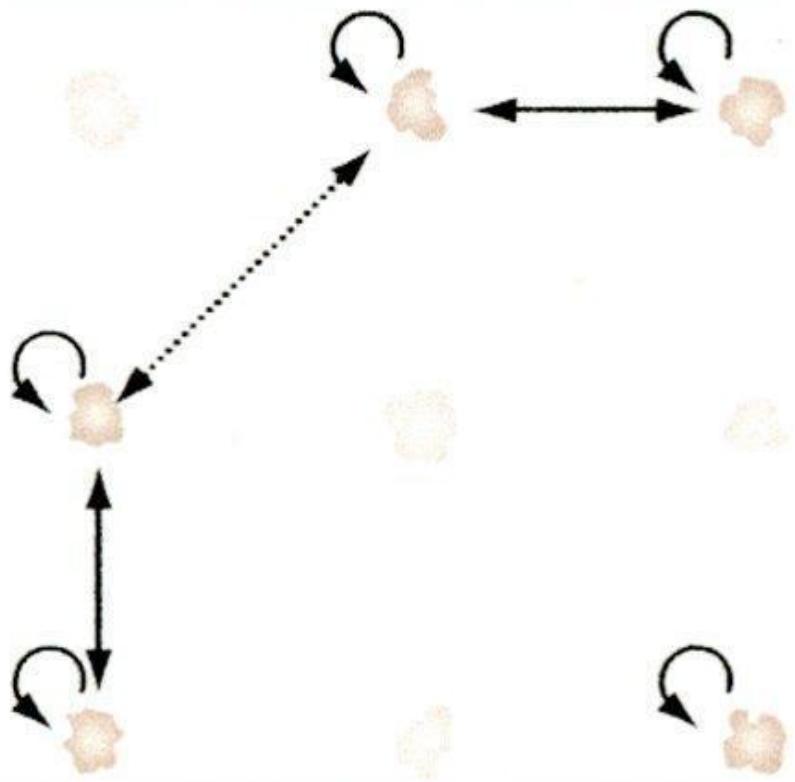
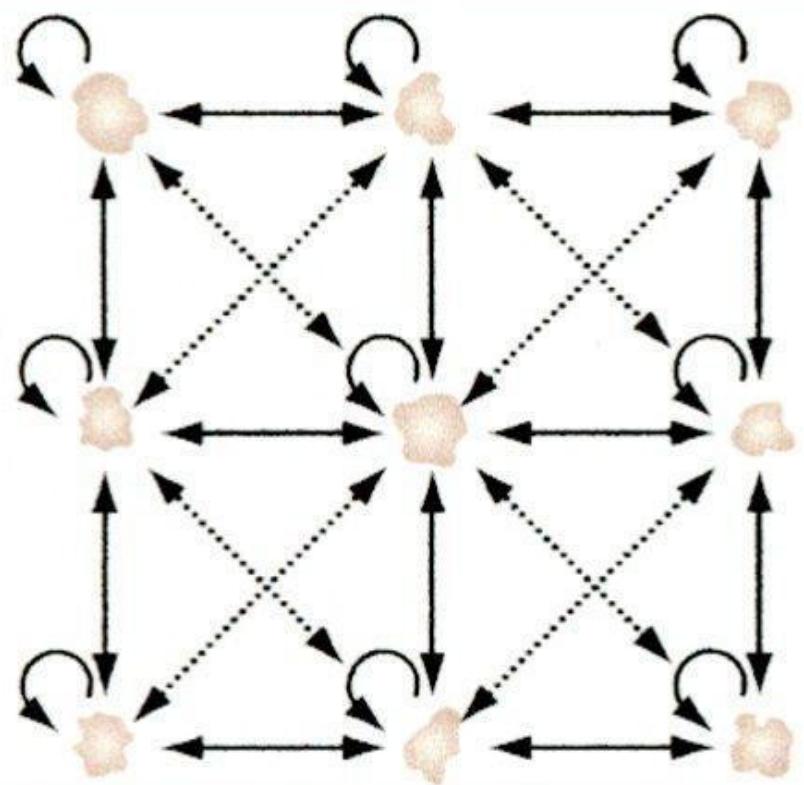


Distance from larval source

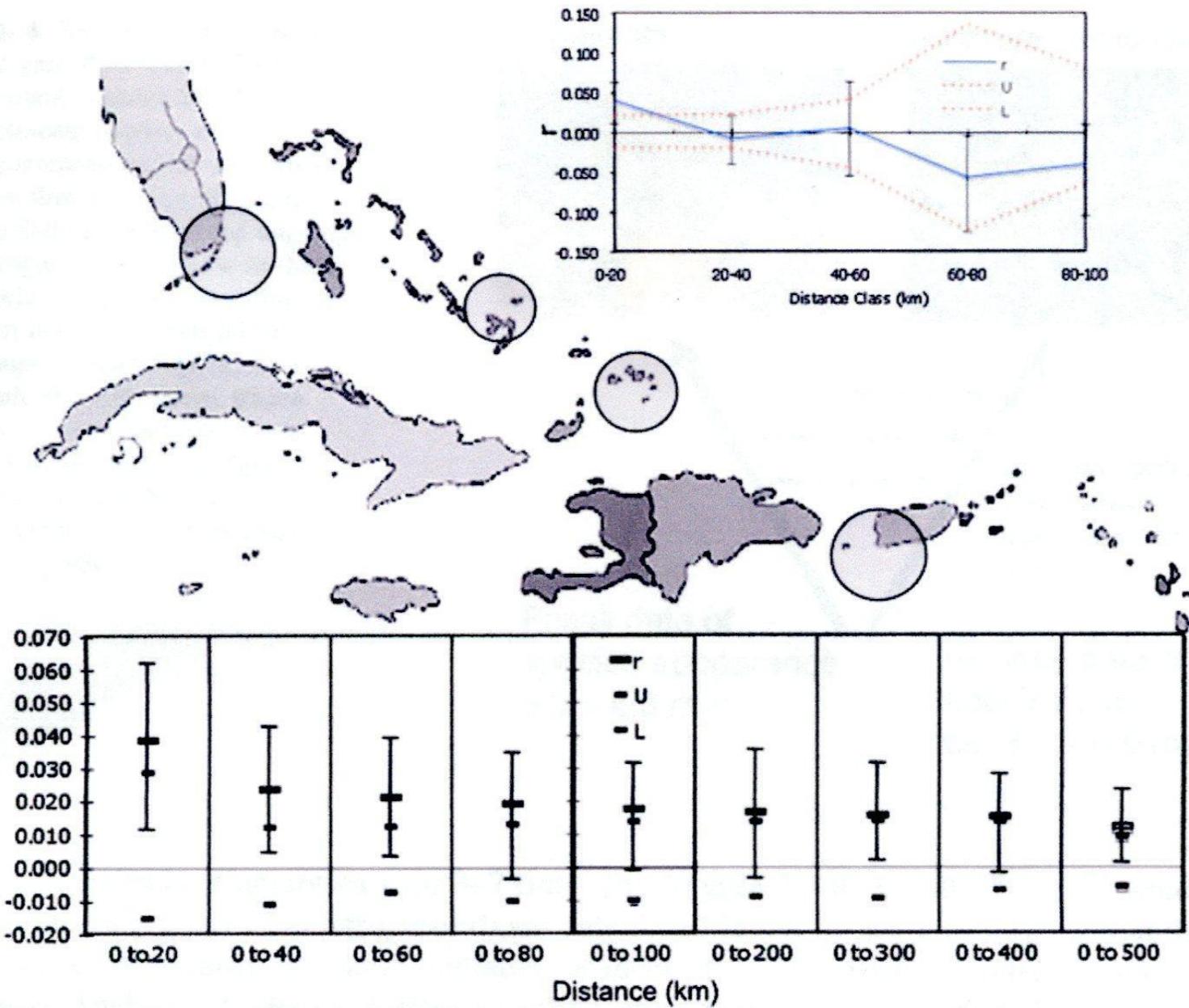


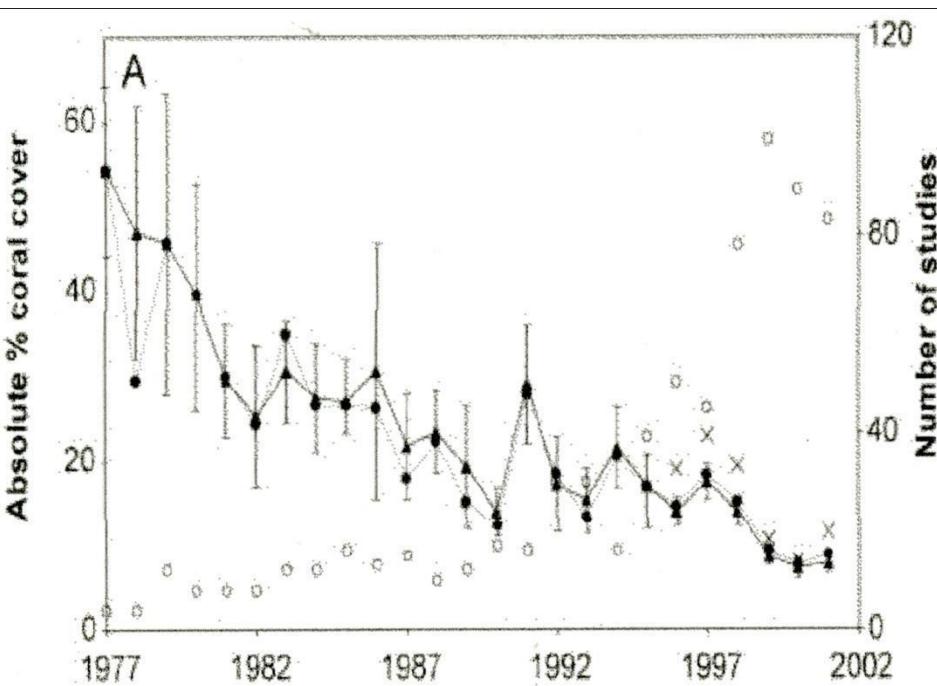
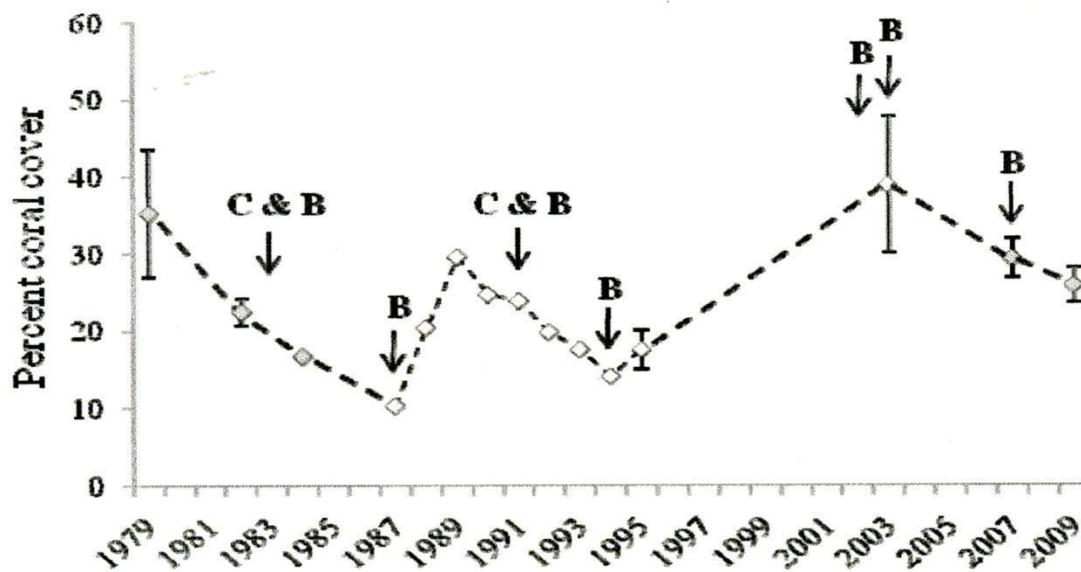
# Evaluation of Extinction Threats

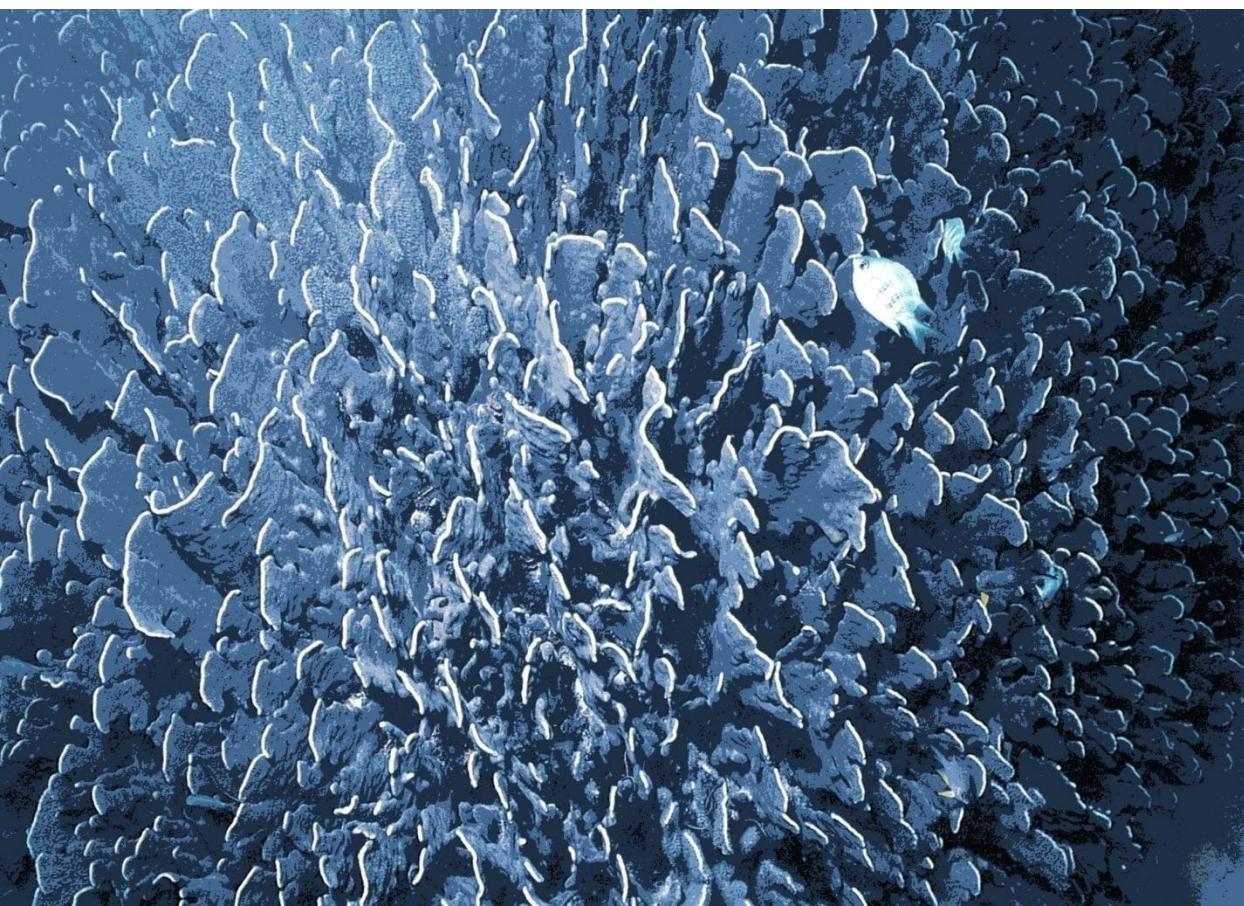
Section 4(a)(1)	Factors	Threat	Importance
5	5	Ocean warming	high
	3	Disease	high
	5	Ocean acidification	med-high
	1	Fishing- trophic effects	medium
	1, 5	Sea-level rise	low-medium
	1	Sedimentation	low-medium
	1	Nutrients	low-medium
5	5	Changing circulation	low
	1	Changing storms	low
	3	Predation	low
	1	Fishing - destructive practices	low
	1	Physical damage - storms	low
	1	Coastal construction	low
	2	Aquarium and curio trade	low
	5	Toxins*	not negligible
	5	Invasive species	negligible-low
	5	Insolation*	probably negligible
	5	Salinity	negligible
	5	Dust	negligible
	1	Physical damage - debris	negligible
	1	Physical damage - tourism/divers	negligible
	1	Physical damage - vessels	negligible



Fewer stepping-stones due to habitat loss



**b****Tiahura (0-5m)**

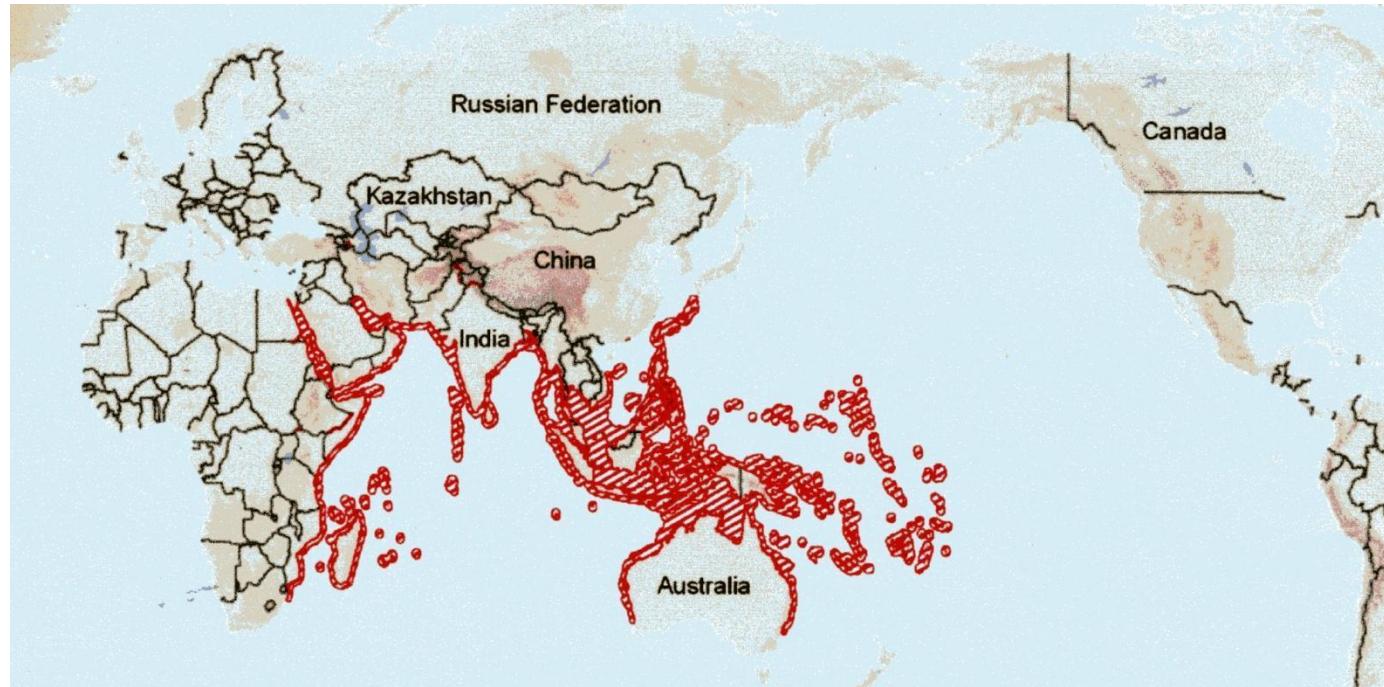
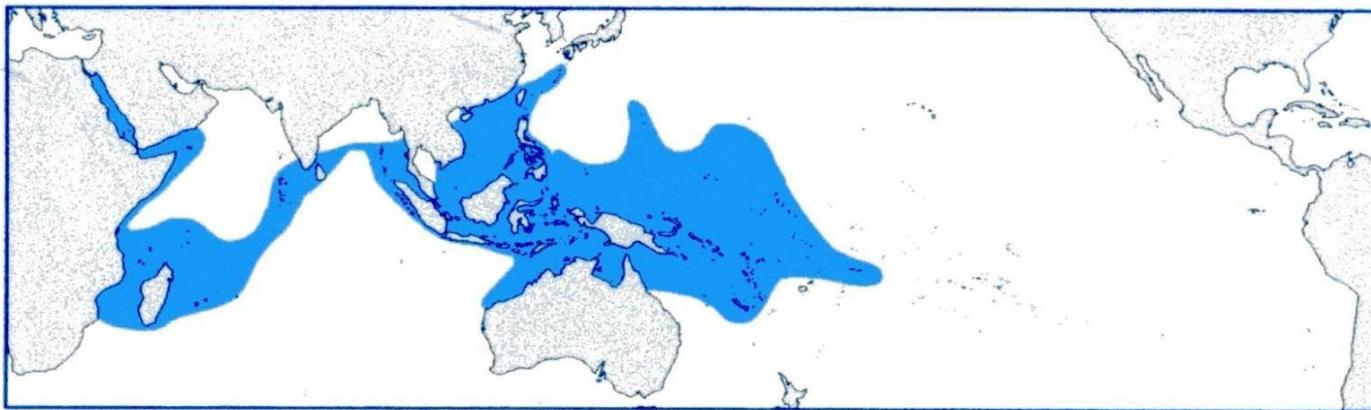








**Global range size** = widespread from Red Sea and east African coast to Okinawa and Samoa, patchy, but locally common throughout





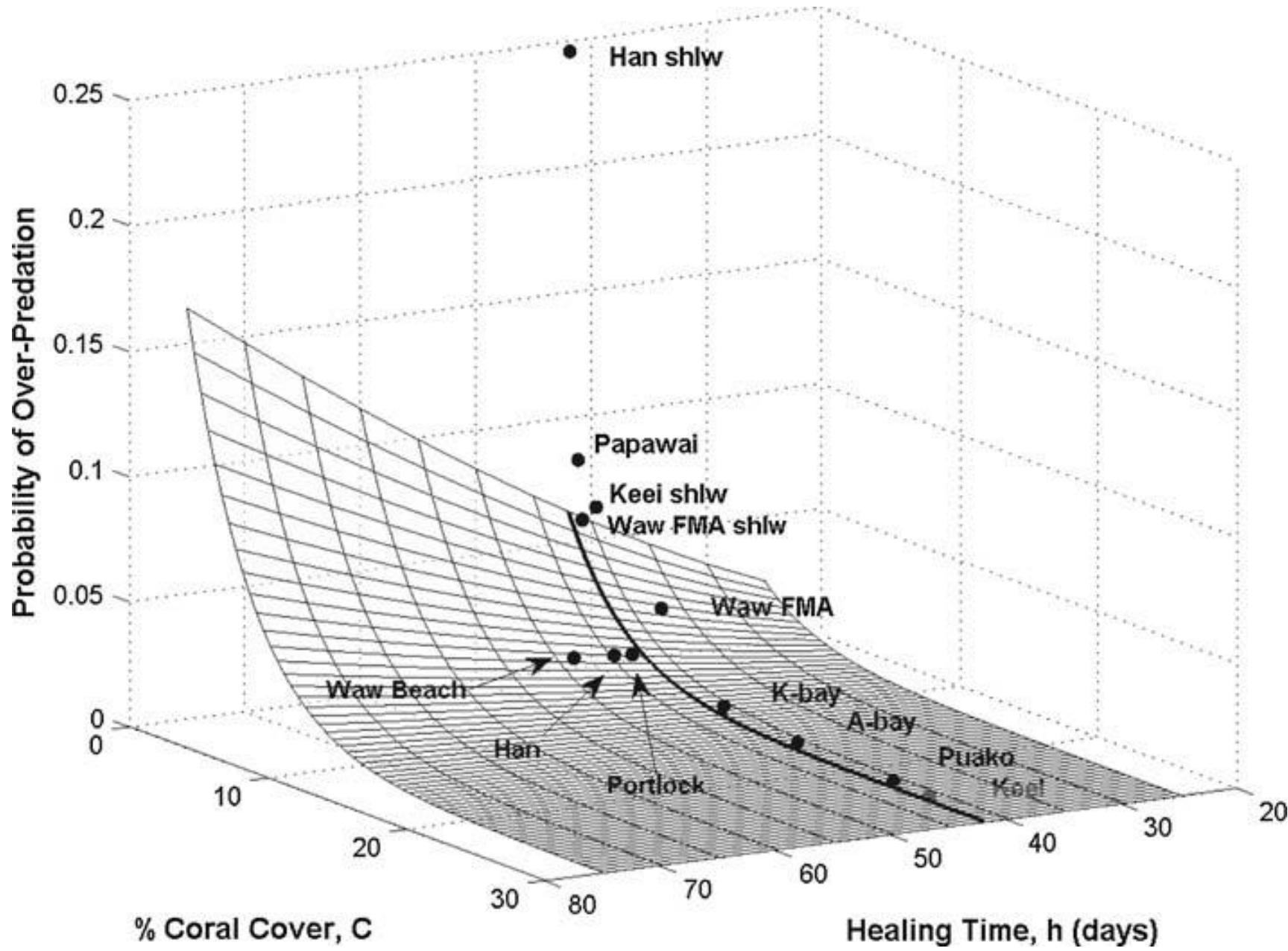
# **Critical Risk Threshold (CRT)**

**PREDATION**

**abundance**

**size distribution**

**stress**



# **Allee effects on corals because adults are sessile**

**1 – fertilization**

**2 – fecundity**

**3 – dispersion**

**4 – connectivity**

**5 - predation**

